Bibliometric Structured Review of Mobile Information Systems

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Abstract. This study attempts to fill the identified research gap in the existing literature through a bibliometric analysis and discovered 20 highly global cited-papers with 1376 citations and yielded eight (8) core categories of knowledge in MobIS: (1) Information Systems, (2) Adoption, (3) Acceptance, (4) Satisfaction, (5) Information Systems Success and (6) Information Systems continuance. The results show that the distribution of the annual papers flows along the downslope. It was a bit stable in 2016 and since then descend from 2017 to 2020. As a young discipline, there is a need for more productivity, impact, and collaboration in the field of MobIS.

Keywords: Mobile Information Systems, Bibliometric, Structured Review, mobIS.

1   Introduction

Mobile information systems (MobIS) is a growing trend in the industry because of its potential to enhance the business processes and performance. Ubiquitous (MobIS) allows interaction of mobile devices and other systems with impact on the society, economy, governance, education, commerce, healthcare [1], and industry [2]. The (MobIS) has been extremely useful during the ongoing pandemic (COVID-19). For instance, recent study of Drew [3] reported the rapid implementation of mobile technology for real-time epidemiology of COVID-19. According to the authors this real-time information systems has potential to showcase data on predictive symptoms, risk factors, clinical outcomes, and geographical hotspots and so far, has generated above 2.8 million users. The use of (MobIS) is relevant in different fields and in academia its research is ongoing because (MobIS) is an evolving discipline.

This study discovered a gap in the study of Shiau, Yan & Lin [4] and this study intend to fill this gap and expand the work of [4]. For instance, the intellectual structure composition of (MobIS) is subject to change from time-to-time and [4] extracted data from the Web of Science from 1996-2015 and this study follow up their study by extracting data from the Web of Science from 2016-2020. Due to the gap in the existing literature, this study proposed the following research questions: (1) Why is im-

portant to explore the trend of the core knowledge and the intellectual structure of the MobIS in detail? Why is TCCM framework relevant to the discipline of MobIS?

MobIS is diffusing across the continents and a recent study investigates the use of interaction design patterns in Brazil with focus on government mobile information systems and discovered that in Brazil, the government's mobile information systems is at the low level of employing the interaction design patterns. This paper could be a panacea for the Brazilian to use governmental services in mobile systems efficiently [5]. Further, Saeed & Xu, [6] extended the Bass model to information system-based services and discovered the effect of dis-adoption and re-adoption in innovation diffusion process. Besides, [7] proposed a MobIS framework for Bangladeshi ready-made garments (RMG) and showcase the relevance of MobIS for empowerment process. The study of He, Nazir & Hussain, [8] emphasised the importance of literature review and mentioned that it will help to understand the researchers and other academic stakeholder's productivity levels, relevant theories and methods that works best in different situations.

The introduction to MobIS precedes the synopsis of MobIS, then followed by methodology section and results section. Also, with discussion, conclusion and finally, the recommendations for the future research.

2 Synopsis of Mobile Information Systems

Combination of mobile technology and information systems evolved as the discipline of mobile information systems. Mobile technology use and advancement is expanding globally and contributes to the ubiquitous of information systems. Information systems has metamorphized over years from traditional record keeping to the present cloud storage system. Mobile information systems is an "information systems in which access to information resources and services is gained through end-user terminals that are easily movable in space, operable no matter what the location, and, typically, provided with wireless connection" [9]. This definition indicate accessibility, technology, operability, and connectivity. MobIS will continue to be relevant to the academic community and the industry because it can provide future new value-added services in different context of use [9]. MobIS addresses a wider user group and pose new challenges such as privacy, users' orientation, poor quality of network connection and use high distraction. Model-based approach and Task-Technology Fit was proposed for the development of MobIS [10] [11]. A recent study also contribute to the literature of MobIS and explored the key content of the MobIS field and identified the intellectual structure of MobIS [4]. The existing studies motivates this bibliometric review and TCCM analysis.

3 Synopsis of Mobile Information Systems

There are different types of literature review, approaches, techniques, and tools (He, et al. 2021) [8]. The earlier studies have employed the traditional method and software to explain different kinds of phenomenon in conjunction with academic commu-

nity productivity. One of such review is bibliometric method. Bibliometric method focus on bibliographic data analysis based on published literature to give insights of the body of knowledge for a specific or combined field of inquiry [12] [13]. This study adopts bibliometric method to explain the phenomenon of mobile information systems. The study utilised relevant literature from leading global database (ISI Web of Knowledge database) and extracted 1074 from 2016-2020 with 37814 references, 3980 author's keywords (Table 1) with the following search query: ((Abstract-Title-Keyword ("mobile information systems"). The total collected data was 1132 and after language exclusion (Portuguese – 12, Spanish – 9, Russian – 3 and Turkish – 3), the English outlet accounts for 1100 and the inclusion of articles and conference proceedings yield 1074. A full record information from Web of Science database with focus on bibliographical information, citation information, abstract, keywords and other relevant information was exported in BibTeX file format. Because of the limitation of 500 dataset per download, the study employed Texmaker (a free cross-platform latex editor) to merge the files. This study utilised bibliometrix R package (R studio) for the data analysis because of its dynamic statistical algorithm and integrated data visualization features [14]. The study combined the bibliometric and TCCM framework to get a better understanding of mobile information systems impact.

Table 1. Demographic Information

Description	Result
Main Information Data	
Timespan	2016-2020
Sources (Journals, Books, and others)	682
Documents	1074
Average years from publication	3.18
Average citations per documents	5.101
Average citations per year per doc	1.183
References	37814
DOCUMENT TYPES	
Article	674
article; early access	28
article; proceedings paper	6
proceedings paper	366
DOCUMENT CONTENTS	
Keywords Plus	1671
Author's Keywords	3980
AUTHORS	
Authors	3221
Author Appearances	3609
Authors of single-authored documents	87

Authors of multi-authored documents	3134
AUTHORS COLLABORATION	
Single-authored documents	95
Documents per Author	0.333
Authors per Document	3
Co-Authors per Documents	3.36
Collaboration Index	3.2

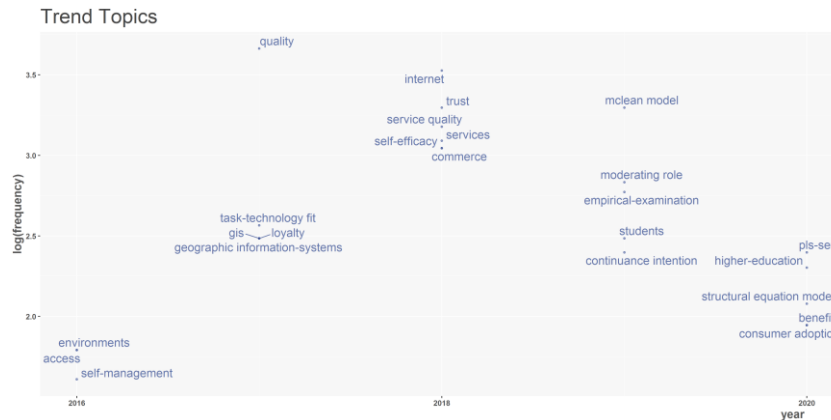## 4   Analysis

4.1   Trends of MobIS Research

Fig. 1. Trends Topic in MobIS research

Shown in fig. 1 are trend topics in MobIS research. Among the top 24 most trend topics, quality has the highest frequency followed closely by internet and trust. The least trending topic is self-management.
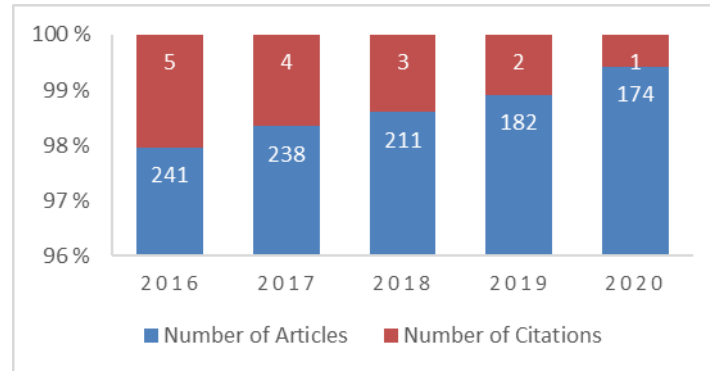
4.2   Yearly Articles vs Citation

Fig. 2. Yearly Articles vs Citation

Fig. 2 shows the number of articles and citation garnered yearly from 2016 to 2010. There is decline in article production from 2016 to 2020. Despite that MobIS is a growing trend, it is unexpected that the rate of publication will keep decreasing yearly. With this constant decline for over four years, there is possibility of further decline in coming years. It can also be seen in fig. 2 that the number of citations increase by the year the highest articles are published. This trend shows that the more articles are produced, the more they attract citations.

4.3   MobIS Sources Citation

Table 2. MobIS most cited sources

Sources	Citations
Mis Quart	1615
Comput Hum Behav	1116
Inform Syst Res	670
Inform Manage-Amster	643
Decis Support Syst	498
Int J Inform Manage	458
J Marketing Res	343
Manage Sci	328
J Manage Inform Syst	323
Eur J Inform Syst	300
J Marketing	296
J Bus Res	286
Lect Notes Comput Sc	284
Comput Educ	268

Internet Res	264
Int J Med Inform	247
Telemat Inform	237
J Assoc Inf Syst	227
Electron Commer R A	224
Inform Syst J	217

In table 2, the most cited sources are shown. The most cited sources are MIS Quarterly followed by Computer and human behaviour while the least in the outlet utilized by researchers that receives citations regarding MobIS is Information systems journal.

Table 3. MobIS most cited sources

Bibliographic Source	h_index	TC	NP	PY
International Journal of Information Management	9	350	20	2016
Electronic Journal of Information Systems In Developing Countries	2	12	12	2016
Jmir Mhealth And Uhealth	5	51	12	2016
Ieee Access	4	33	11	2017
Telematics and Informatics	6	256	11	2016
Amcis 2017 Proceedings	0	0	10	2017
Internet Research	6	168	10	2016
Iet Intelligent Transport Systems	4	24	9	2016
Information Systems Frontiers	5	127	9	2017
International Journal of Mobile Communications	2	34	9	2016
Centeris 2018 - International Conference on Enterprise Information Systems / Projman 2018 - International Conference on Project Management / Hcist 2018 - International Conference On Health And Social Care Information Systems And Technologies, Centeri	2	12	7	2018
Industrial Management & Data Systems	3	97	7	2016
International Journal of Medical Informatics	6	91	7	2016
Isprs International Journal of Geo-Information	3	29	7	2016
Journal of Computer Information Systems	2	27	7	2017
Sustainability	2	15	7	2017
Amcis 2016 Proceedings	0	0	6	2016
Computers in Human Behavior	4	158	6	2016
Information Technology & People	4	37	6	2017
Jmir Medical Informatics	2	15	6	2016
International Journal of Information Management	9	350	20	2016
Electronic Journal of Information Systems In Developing Countries	2	12	12	2016
Jmir Mhealth And Uhealth	5	51	12	2016

Table 3 shows MobIS bibliographic sources of articles. As shown in the table, International Journal of Information Management has the highest with the **total citations** of 350, the **number of publications** which amounts to 20 and h_index of 9 in the year 2016. Closely followed is Telematics and Informatics

4.4 MobIS Distribution of Research Methods and Theories

Table 4. MobIS Distribution of Research Methods

Utilized Methods
Mixed methodology
Quantitative methodology
Qualitative method
Geometric Constraint Model (GCM)
comparative analysis
technological approach
IDEF0
IDEF3
WFD
Constructive learning methods
Interpolation methods
Utilized Methods
Mixed methodology
Quantitative methodology

Table 4 evinces the methodological approach utilized in producing scientific articles. The research methods adopted in the publications include mixed methodology, quantitative methods, qualitative method, geometric Constraint Model (GCM), comparative analysis, technological approach, constructive learning methods, interpolation methods and IDEF0, IDEF3, WFD. Such methodologies as IDEF0, IDEF3, and WFD were implemented for business processes description.

Table 5. MobIS Distribution of Theories

Description		Result
acceptance model	motivation theory	boulder model
design theory	shafer evidence theory	conceptual-model
innovation diffusion-theory		confirmation model
technology acceptance model		dual-model
utaut model		effects models
cognitive theory		evaluation model

social cognitive theory	expectation confirmation model
management theory	hegadas model
complexity theory	hierarchical model
structuration theory	hofstedes model
self-determination theory	integrated model
protection motivation theory	mclean model
prospect-theory	model development
unified theory	new-model
	structural equation models
	success model
	theoretical-model

The theories utilized in MobIS literatures are shown in table 5. The theories are categorized into three namely, information systems theory, psychology cognitive theory and others. According to [15], effective application of theory is critical to the development of new knowledge in information systems (IS) research. As shown in the table, psychology theories emerge in MobIS literatures. This is consistent with the study of [15] which states that IS research draws from a diverse set of disciplines, with Psychology emerging as a consistently dominant source of theories for IS.

4.5   Authors Productivity Over Time

Table 6. Authors production over time

Author	Year	freq	TC	TCpY
Defranco A	2016	1	27	4.5
Defranco A	2017	1	11	2.2
Defranco A	2019	2	1	0.3
Ferreira Mj	2016	2	0	0.0
Ferreira Mj	2017	2	6	1.2
Ginige A	2017	1	4	0.8
Ginige A	2018	1	0	0.0
Ginige A	2019	3	0	0.0
Ginige A	2020	1	0	0.0
Kazimierski W	2016	3	40	6.7
Kazimierski W	2019	1	0	0.0
Kim J	2016	1	1	0.2
Kim J	2017	4	20	4.0

Kim J	2018	1	52	13.0
Kim J	2019	2	2	0.7
Li Y	2016	3	11	1.8
Li Y	2017	3	9	1.8
Li Y	2018	1	4	1.0
Li Y	2019	1	3	1.0
Li Y	2020	1	0	0.0

Regarding authors' production over time, we investigated the top six authors and our findings showed that the majority of those top authors were already publishing articles on MobIS by the year 2016. As seen in table 5, the author Li Y. has the highest publication over time having had several articles published yearly consistently since 2016 till 2020.

Table 6. Authors production over time

Author	h_index	g_index	m_index	TC	NP	PY_start
Li Y	4	4	-	27	10	2016
Zhang X	1	2	0.17	8	8	2016
Liu Y	3	7	0.50	140	7	2016
Ginige A	1	2	0.20	4	6	2017
Oliveira T	4	6	0.67	156	6	2016
Al-Emran M	2	4	-	25	4	2018
Defranco A	2	4	0.33	39	4	2016
Ferreira Mj	1	2	0.17	6	4	2016
Kazimierski W	3	4	0.50	40	4	2016
Kim J	3	4	0.60	18	4	2017
Liu J	2	4	0.33	81	4	2016
Moreira F	1	2	0.17	6	4	2016
Morosan C	2	4	0.33	39	4	2016
O'Connor Y	2	3	0.33	13	4	2016
Schmidt R	1	2	0.25	6	4	2018
Sharma Sk	3	4	0.60	84	4	2017
Wang J	3	4	0.50	90	4	2016
Wlodarczyk-Sielicka M	2	4	0.33	30	4	2016
Zhang F	3	4	0.50	21	4	2016
Zhang M	2	4	0.50	22	4	2018

*TC: total citations; NP: number of publications; PY: publication year first indexed

As shown in Table 6, among the top 20 most cited authors, only two have received ≥100 citations, three have been cited ≥80 times, and five have not reached 10 cita-

tions. Overall, those authors who had the largest number of citations also had the highest h-index (i.e., h-index > 4). However, Li Y. who has been cited a total of 27 times had a h-index of 4 while Liu, Y. with 140 citations had a h-index of 3. According to [16] a bigger number of publications was an indicative of a higher author's scientific productivity as measured by the h-index and/or the g-index, but for Li Y. (h-index = 4, g-index = 4) that has the highest publications (10) and only received 27 citations so far. Considering the length of academic career, the m-index showed that Oliveira T., (0.67), and Kim J., (0.60), Sharma Sk (0.60), were the authors who had higher growth in their scientific productivity.
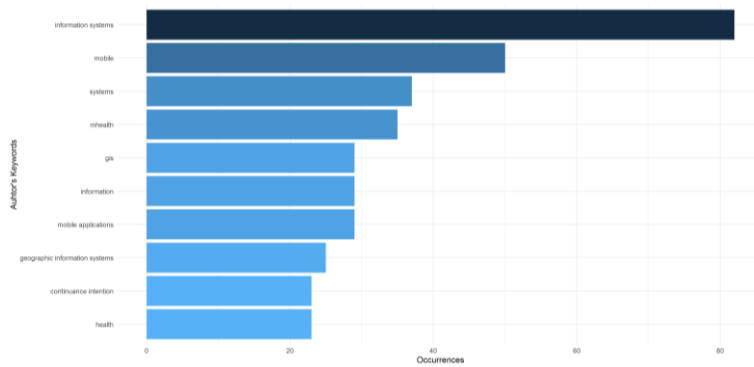
4.6   MobIS Relevant Keywords

Fig. 3. Relevant Keywords

The analyses of the 10 most frequently used terms included in all the retrieved documents using the author keywords and the keyword plus terms (i.e., keywords associated to the manuscript by Thomson Reuters' Institute for Scientific Information (ISI) WOS databases) are shown in Fig. 3. A total of 3980 author keywords were retrieved. Based on the higher frequency of keywords Information systems is most used and relevant keyword followed by mobile and systems. The least amongst them is health and continuance intention.

4.7   MobIS TCCM Analysis

Using a simple framework of TCCM, in which T stands for theory, C for context, C for characteristics and M for methodology: accordingly, the following section deals with analysis of the findings in relation to theory development, context, characteristics and methodology of MobIS as revealed in the bibliometric analysis based on the data generated from WoS databases from 2016 – 2020.

Theory development (T)
In this review, several theories were adopted and as expected in the realm of information systems since our focus is on mobile information systems. However, few theories utilized are from the psychology field to explain the concepts of mobIS. As revealed in Table 5, several models were also used in the mobIS research. According

to [15], effective application of theory is critical to the development of new knowledge in information systems (IS) research. With the emergence of psychology theories in MobIS literatures, this study is consistent with [15] research which founds that IS research draws from a diverse set of disciplines, with psychology emerging as a consistently dominant source of theories for IS. New theoretical lenses that could explain uncovered areas in mobIS is needed as driving empirical studies with theories is necessary. Earlier studies suggested [17] that without a close interaction between theoretical development and empirical reality, mobIS could become merely an area of application for applied concepts from other disciplines. Arising from this, the need for new theoretical frameworks and models to explain the link among the concepts related to mobIS is recommended.

Context (C)

Research in the field of mobIS has advanced our knowledge on interaction design patterns [5], relevance for empowerment process [7] and its potential to enhance the business processes and performance. As revealed in the analysis, the context at which the mobIS research are carried out include largely Information systems, Mobile health, Mobile application, social apps. More research context is required and should also be extended to developing countries as the developed context presently dominates the research space.

Characteristics (C)

Methodology (M)

As reported in Table 4, different methodological approaches are widely used in this area of research. However, the methods used in mobIS research have become sophisticated spanning from geometric Constraint Model (GCM), comparative analysis, technological approach, constructive learning methods, interpolation methods and IDEF0, IDEF3, WFD. The challenge is to develop more mixed-method approaches when studying concepts in relation to mobIS research. To improve the methodological rigor of mobIS research, the use of more diverse analytical techniques and methods, such as content analysis, qualitative research, meta-analysis and multi-level methodologies is recommended since survey, descriptive and mixed method are mostly used in prior research in the area.

5   MobIS Results, Discussion and Conclusion

The current study aimed to assess the scientific literature on MobIS from 2016 - 2020. By using the TCCM framework, we were able to uncover some significant theoretical and contextual insights.

Theoretical insights

Looking from a theoretical standpoint, we observed a need for further development and use of more psychological-related theories. As noted in Figure 1, we found that there were limited psychological cognitive theories. These theories focus on human's

ability to problem-solve, make decisions, learn, and collaborate among others [18]. Since mobIS have unique capabilities to support the ever-increasing mobile technology users and processes [19], psychological cognitive theories should be developed.

Contextual insights

Contextually, the TCCM framework shows a gap in the context already covered in the field of mobIS. So far, the contextual coverage of the literature, especially between 2016 and 2020, have already touched on some relevant research areas (as depicted in Figure 1 and Table 7) such as geographic information systems, mobile computing, service quality, mobile adoption, cloud computing and commerce. We noticed that more attention is yet to be expended on mobile-data research [20]. The rapid growth of mobIS, over the years, with it, brought opportunities and challenges of mobile data from sundry standpoints [21].

To summarise, a total of 1040 documents were produced between 2016 and 2020 - considering only journal articles and conference proceedings. Out of the 1040 documents, 95 were single authored. The average authors per document was 3 and the collaboration index was 3.2. The most productive author was Kim J (citation: 75, documents:8). On the average, about 3 publications were made per year and an average citations per document. The most cited source was the Mis Quarterly (1615 citations). The bibliographic source with the highest impact score was International Journal of Information Management (impact score: 9).

5.1 Managerial implications and direction for future studies

MobIS research and technological advancements go hand-in-hand. Thus, the persistent decline in mobIS research productivity should be addressed urgently. The cause of the decline is yet to be ascertained, at this point. We recommend that studies should be conducted to investigate this issue. Empirical work should be conducted with goals of developing cognitive theories to support mobIS. In the same vein, future researchers should also explore mobile data from various perspectives such as security, privacy, monitoring.

5.2 Study Limitations

One of the main limitations we experienced was our inability to extract more than 1040 documents (journal articles and conference proceedings) due to the limited timespan of four years (that is, 2016 to 2020).

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